Automated RFID based Library Management Systems

Moiz S. Ansari
Faculty of Engineering Science & Technology
Isra University
Hyderabad, Pakistan
e-mail: moizs.ansari@gmail.com

Naveed Ghani Khatri
Faculty of Engineering Science & Technology
Isra University
Hyderabad, Pakistan
e-mail: naveed-ghani@hotmail.com

Abstract- RFID provides one of the best solutions for the identification of assets. RFID is a new generation which provides auto identification and data collection technique. RFID allows identification of tagged books, using radio frequency. RFID based Library Management System (LMS) will help us to increase the flow of transaction for a library. The proposed system of LMS is based on UHF RFID readers, along with the antennas at library entrance and on all other transactional points of the library. This work discusses elimination of transactional module from existing RFID based Library Management System.

Keywords: RFID, UHF RFID readers.

I. INTRODUCTION

RFID is being used in variety of fields like; automotive tracking, animal tracking, and all types of assets tracking and identification. Designers such as Ideas by Gul Ahmed, Amir Adnan tag their products with the RFID chip, which is the most common example of interaction with RFID. However garments and books are both separate things. Bar codes, magnetic cards are the better options for identification but not the best. RFID tag does not have to be visible in order to let them read, it can be read once the tag is in range of reader irrespective being visible or in line of sight. Another advantage of using RFID in library is, it stores more than one variable; i.e. it stores stack number, accession number, book number, author information etc, where as barcode is limited to just one identification number.

II. LIBRARY AND ITS FUNCTIONS

Library; is collection of all the sources, resources, including books, DVDs, and all other informative materials on a one common place. Besides all above some libraries do have access points, for maps, prints, or other documents. A good librarian arranges the library in order to easy, quick, efficient reach to all the materials to the users.

The following are the tasks generally performed in the library. Circulation, Collection and Technical Services, they all includes handling user accounts and issuing and returning of books; order materials, Work behind the scenes cataloguing and processing new materials and de-accessioning weeded materials; respectively.

III. LIBRARY USING RFID

Basic tasks in RFID based LMS include the planning for gaining of materials, arranging the acquired materials according to the library classification, the de-accessioning of materials, and administering library computer systems.

The proposed system will perform following tasks easily; using RFID technology,
- Accessing number of books at a time.
- Searching a particular book to check its presence in the library, through database applications.
- Locating the physical location of the book.
- Accounting/Stock verification of the materials.

While using RFID based LMS librarian can process issuing, re-issuing, and returning formalities really fast, all on few clicks. RFID based LMS also provides monitoring and searching system. The monitoring system will continuously monitor the library gates and will act as a chambermaid, so that the books taken out without completing formalities can be traced out easily and will alarm the librarian. The searching module provides the fast searching of books using RFID handheld reader (moveable). The physical location of the books in racks can be easily traced using this module.

IV. TECHNICAL HIGHLIGHTS

A. Moveable Module:

UHF RFID handheld reader is used (Fig 1) generally operated from ~ 800 - 900 MHz, using

Table 1: Format of storing information in RFID

Tag	Description	Example
Library Member Tag	Library member tag contains a 16 digit value where first 7 characters are 'MSAFEST' which will be followed by the 9 digit Employee/ Student ID (0610-TC01/0610-0001).	MSAFEST0 610-TC01/MSAF EST0610-0001 Here, '0610-0001' is an Employee ID
Book Tag	Book tag contains 16 digit values where first 3 characters are 'PCS', 3 characters are 'HTS' followed by the book no. if the book number has less than 9 digits, then it will be prefixed by '0's.	PCSHTS000 0000123 Here, '123' is a book number.

Windows Embedded CE 5.0 and full VGA, daylight readable touch screen display and well laid out backlit keyboard. [1]

Fig 1: Handheld RFID device [4]

B. *Stationary Module:*

Stationary RFID reader, at entry and exit points (Fig 2) supporting four antennas, operating at UHF ranges of 865-870MHz, 902-928MHz and 950- 956 MHz (further depends upon usage). [1]

RFID tags used are UHF passive tags mounted in books which have the 96 bits memory for hexadecimal data storage. It operates at frequency from 850 MHz to 950 MHz.

UHF technology gives low cost very long read range that's the only reason to use UHF. The read range of UHF reader is up to 2 meters, which is sufficient to monitor the movement of books across the entry and exit points.

The read range of search module handheld reader is up to 30 cms which will be useful for locating a particular book in a rack. Few of readers can read over 1000 tags per second, but practically it is decreased to 100 tags per second especially when we have to get insulated from RF noise. All of these benefits make the UHF technology the ideal choice for Library applications. [1]

Fig 2: RFID stationary Module [2]

V.   RFID BASED LMS ARCHITECTURE

To provide proper management to library two types of modules are introduced; the manual intervention is minimized as the automatic identification of books is now implemented because of RFID. grammar:
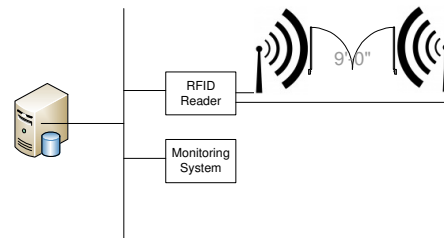
A. *Monitoring Module*

Fig 3: Monitoring Module

Monitoring Module (fig 3) will be installed at the entry and exit points of the library to monitor the incoming / outgoing objects continuously. The reader reads the RFID tags attached to the books and student/ employee ID number and will send the tag IDs to the monitoring Module which in turn will save that information in database. The Module differentiates the book IDs and library member IDs by checking the format of the ID value (7 alphabets is student/ employee ID number, and 6 alphabets book identity). The Module alarms the librarians whenever there is a movement at the gates without librarian consent.

B. Seacrh Module

The interaction of searching module is given in (fig 4). The module navigates through books to find the proper destination physically; a process that may be assisted through RFID tagging. Using RFID tags to keep in track with library books could increase security and ease. The RFID tag attached with the books contains the book number. The books can be found by using handheld RFID reader using any of the specifications like book number, book name, author name and publisher name.
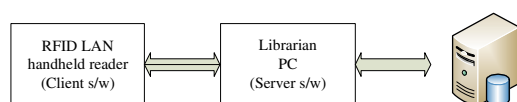

Fig 4: Searching Module

Generally the beep sound will be given as soon as the particular book is in range of the handheld device, and is identified. If except book id every detail is given to find a book, like book name, author name and publisher names, then the user will communicate with the server program to get the required book id from database.

The main benefit is that books can be checked quickly using a handheld reader, instead of spending weeks or so for a single book.

VI. EXPERIMENTS ON TAG POSITIONING

In order to get maximum efficiency of the tags, proper position of tag does matters. Randomly 9 positions are selected for tagging. Determined by the (fig 5).

Fig 5: Position of RFID Tag

A. Monitoring Module

Sample size of 60 books of different sizes was taken and checked with all the tag positions in the environment of single antenna kept at the height of 1.5 meters from the ground.

Simulation test was conducted to find out the percentage of books detected by RFID reader when people were made to move by holding the books in different ways across the gates.

The result is as shown below.

Tag Position	Total books	Read %	Average distance
1	60	63%	86 cms
2	60	77%	76 cms
3	60	85%	91 cms
4	60	65%	71 cms
5	60	80%	65 cms
6	60	77%	65 cms
7	60	87%	87 cms
8	60	55%	70 cms
9	60	40%	60 cms

Table 2: Monitoring Module read Percentage. [1]

When same test was conducted with 2 antennas at the two sides of the gate as shown in fig 4, approximately 100% detection was found for the tag position-7, and 98% detection was found for the tag position-3, both with the average maximum read distance of 1.5 meters

B. Searching Module

"The books of different sizes kept in 8 racks have been checked with the different tag positions to find out the percentage of tags detected by the handheld reader." [1]

The result is as shown as below

Tag Position	Total books	Read %
1	100	92%
2	100	90%
3	100	76%
4	100	56%
5	100	89%
6	100	86%
7	100	88%
8	100	67%
9	100	96%

Table 3: Searching Module read percentage. [1]

"The results indicated that tag position 1, 2, 5 and 9 have maximum read rate of 92%, 90%, 89% and 96% respectively. But these positions didn't are not good in monitoring module."

After reviewing the facts and figures of tag positioning, position 7 is the best possibility for deployment of the tag. RFID tags should be pasted in all books at this position." [1]

VII. ELIMINATION OF TRANSACTIONAL MODULE

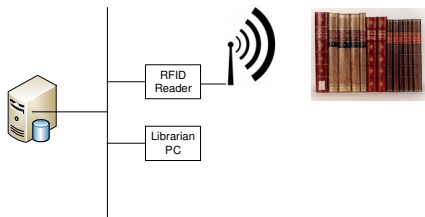In existing RFID based library Management Systems we have transactional module.

Fig 6: Transactional Module.

The interaction of transaction module is given in (fig. 6), Here RFID provides the transactions like issuing, reissuing, and returning of material. Limitation we have is, one has to consume time in order to charge his/her account for issuance of book or have to go to librarian for the transaction.

But in automated RFID based library management system as in (fig 7) we don't need to consume time. if library membership tag and book tag is read with the difference of 1 microsecond, system will send the tag numbers to the librarian who will automatically update database for the transaction but if book tag is read and library member tag is not read or vice versa, within difference of 1 microsecond then system will alarm to the librarian for unwanted movements.
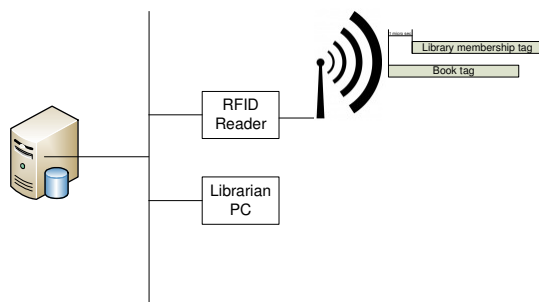

Fig 7: Automated RFID based LMS Architecture.

CONCLUSIONS

RFID in library speeds up all the processes like issuing, reissuing returning books, monitoring of books regarding to anti-theft, books searching processes.

Performance of a system depends upon the information on the tag, effectiveness of RFID reader position, tag position. And they all depend upon the cost. Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing.

Updating of manual book keeping, books are now more easily traceable, Improved utilization of resources like manpower, infrastructure etc, Less time consumed as no line of sight is mandatory, minimized manual intervention, minimized manual errors, availability of the long lasting tags, fast access to books, are the main advantages after implementation of RFID based LMS.

Automated RFID based library management system will increase the speed of transaction as issuing and returning back is now automated

FUTURE WORK

In future the tag system can be implemented in any type of asset tracking, especially in multi-national offices to keep track in their office files, often DVDs. It can also be used in laboratories for tracking of equipments. RFID can be implemented in public transits for avoidance of unauthorized travel.

REFERENCES

[1] RFID Based Library Management System Dhanalakshmi M, Uppala Mamatha, Delhi University, India

[2] http://www.mwjournal.com/Journal/Modern_RFID_Readers/AR_4830/

[3] http://www.electro-tech-online.com/electronic-projects-design-ideas-reviews/96587-rfid-locator-2.html

[4] Google images

[5] http://www.rfid.com/3rfid869/nordicuhf.html/

[6] http://www.rfid-handbook.de/

[7] http://www.rf-id.com/

[8] http://www.thefreedictionary.com/library